Space Science Seminar
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The Top Half of the Sun's Magnetic Dynamo

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The Sun's 22-year magnetic cycle is thought to be produced through two processes: 1) stretching poloidal magnetic field lines via the shear in the Sun's differential rotation to produce toroidal magnetic fields, and 2) transport of the toroidal magnetic fields to the poles to reconstitute the poloidal field. Given the emergence of the toroidal field in tilted, bipolar active regions, surface flux transport has been shown to reproduce much of the complex evolution of the Sun's photospheric magnetic field - the top half of the Sun's magnetic dynamo. Surface flux is transported by flows in the surface shear layer - the axisymmetric differential rotation and meridional flow and the non-axisymmetric convective motions (granules, supergranules, and giant cells). We have measured these flows by correlation tracking of the magnetic elements themselves, correlation tracking of the Doppler features (supergranules), and by direct Doppler measurements using SDO/HMI data. These measurements fully constrain (no free parameters) the flows used in our surface flux transport code - the Advective Flux Transport or AFT code. Here we show the up-to-date evolution of these flows, their impact on the detailed evolution of the Sun's photospheric magnetic field, and predictions for what the polar fields will be at the next minimum in 2020.

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